

Exercise 1: AdaBoost - Updates

Suppose you apply AdaBoost on a data set \mathcal{D} consisting of 19 instances $(\mathbf{x}^{(1)}, y^{(1)}), \dots, (\mathbf{x}^{(19)}, y^{(19)})$. AdaBoost just completed the $(m-1)$ -th iteration and the weights for the next iteration are:

$$w^{[m](i)} = 0.01 \quad \text{for } i = 1, \dots, 10, \quad \text{and} \quad w^{[m](i)} = 0.1 \quad \text{for } i = 11, \dots, 19.$$

For the beginning of the m -th iteration consider three cases:

- (a) $\hat{b}^{[m]}$ is only wrong for $i = 5$ and the rest is correct.
- (b) $\hat{b}^{[m]}$ is correct for $i = 11, 12, 13, 14, 19$ and the rest is wrong.
- (c) $\hat{b}^{[m]}$ is only correct for $i = 10$ and the rest is wrong.

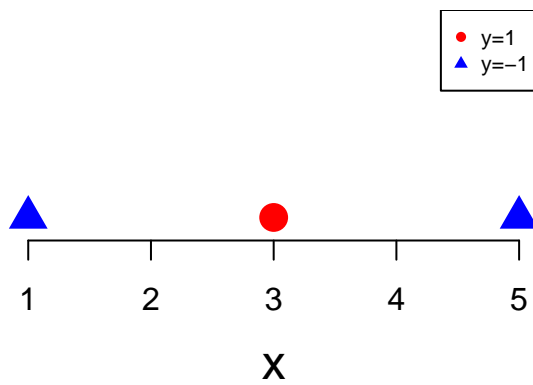
Compute $\text{err}^{[m]}$, $\hat{\beta}^{[m]}$ and the new weights $w^{[m]}$ before the normalizing step for each case. Use the following table:

Case	$\text{err}^{[m]}$	$\hat{\beta}^{[m]}$	$w^{[m+1]}(i)$
(a)			
(b)			
(c)			

Hint: You can use that $\sqrt{99} \approx 9.95$ and $99^{-1/2} \approx 0.1$.

Exercise 2: AdaBoost - Decision Stump

Suppose you apply AdaBoost with a decision stump on the data set as in the following figure:



- (a) What would be a decision boundary for the first decision stump?
- (b) How do the weights of the points change after the first iteration?
- (c) How many iterations are at least needed such that AdaBoost's training error is zero?